REMARKS

Claims 73-83 and 85-94 were examined and amended. New claims 105 and 106 have been presented. Claims 95-104 have been cancelled. No new matter has been presented.

Objections to the Drawings

The drawings are objected to because "modulating an amplitude of the WDM optical signal" as claimed in claim 85 is shown in Figure 10 as "pulse modulator" referenced by 1729.

The term pulse modulator labeled in the drawings such as that shown in Fig. 10 represents a device that produces a pulse-like optical output. It is therefore apparently logical to use the term pulse modulator (1123) to define a device that output optical pulses such as RZ or NRZ according to their definitions stated in paragraphs [0068] and [0069]. Furthermore, the purpose and functionality of "Pulse Modulator" are clearly and unambiguously defined and stated in the specification as can be seen in paragraphs [0083] and [0084]. We respectfully do not think that the term pulse modulator is not consistent with claim 85. Whereas claim 85 says: "modulating an amplitude of the WDM optical signal … comprising a plurality of return-to-zero <u>optical pulses</u>." It is therefore substantially clear that the functionality of the pulse modulator is to produce such said optical pulses.

Rejections under 35 USC §102

The examiner has rejected claims 73 and 79 under §102(e) as anticipated by Liu et al. (US Pub. 2003/0090768).

Rejections under 35 USC §103

Claims 74 and 86 stand rejected under §103(a) as being unpatentable over Liu et al. in view of Bergano et al. (US Pub. 2004/0161245).

Claims 75-78 and 80-82 are rejected under §103(a) as being unpatentable over Liu et al. in view of Sarchi et al. (US 6,577,800).

Claims 83 and 91-94 stand rejected under §103(a) as being unpatentable over Liu et al. in view of Taga et al. (US 5,872,647).

Claims 85 and 87-90 are rejected under §103(a) as being unpatentable over Liu et al. in view of Bergano et al.

The grounds of rejection are respectively traversed.

In one embodiment of the present invention, as set forth in claim 73, a fiber optic network is provided for carrying optical signals. At least one optical fiber had embedded therein an optical signal comprising return-to-zero phase shift key (PSK) optical pulses. At least one laser generates a cw optical signal. At least one pulse modulator is provided to transform the cw optical signal into a pulsed optical signal. The pulse modulator has a bias and the drive voltage to form optical pulses selected to achieve maximal spectral efficiency of PSK transmission, form optical pulses that mitigate non-linearities of the PSK transmission line and minimize adjacent channel crosstalk. The bias and the drive voltage of the pulse modulator are selected according to the characteristics of laser optical power, network channel spacing, the length, the dispersion, and non-linearities of the transmission network. The pulse modulator is configured to use electro-optics to generate optical pulses using amplitude modulation of a cw optical signal. The optical pulses have a duration that is ½ or less that of the data bit rate. At least one electro-optical data modulator is provided to encode the data for transmission in the fiber optic network. A WDM combiner combines multiple optical signals corresponding to multiple channels with arbitrary polarization states selected from at least one of, linear, circular, or elliptical.

Claim 73 includes the following: spectral efficiency (ratio of information bandwidth to channel spacing) and WDM transmission such as adjacent channel crosstalk, selecting an optical pulse shape correctly to achieve maximum transmission performance, optimal optical pulse shape that balances fiber nonlinearities and WDM channel crosstalk, optical pulse shaping of PSK signals to provide optimal pulse shape, and a measurable metric for the pulse shape such as extinction ratio of the optical pulse.

Liu, et al., is directed to polarization interleaving of PSK of RZ optical pulse and fails to address the elements in the preceding paragraph. Liu, et al., defines a PSK of RZ optical pulse in conjunction with polarization interleaving. In paragraph [0005] as well as in Figure 1 of Liu, et al., two orthogonally polarized PSK RZ optical pulse streams are combined before embedding into an optical fiber or a fiber optic network.

Liu, et al., fails to teach the concept of pulse shaping for mitigation of fiber nonlinearities regardless of the polarization state of the PSK RZ optical signal. Liu, et al., specified not only dispersion-managed link (see Figure 1) which typically uses not only non-zero dispersion fiber but also requires different types of fibers at the transmitter and receiver. As set forth in claim 79 of the present invention, pulse shaping is used to achieve optimal transmission performance in a

non-zero dispersion fiber without the specific requirement of dispersion-managed link or any pre- or post-dispersion compensation.

Regarding claims 74 and 86 of the present invention, although RZ and NRZ formats are known concepts, the definition of an NRZ pulse is different than the conventional definition of an NRZ pulse. A conventional NRZ signal has pulse peak that essentially occupies the entire bit period, and the edges of the NRZ pulses exist and extinguish almost completely when there is a logical transition between the adjacent bits: logic one to logic zero. For example, see Bergano, et al's, definition of NRZ in paragraph [0005]. For PSK, the NRZ pulse is defined in Bergano, et al., as a signal with waveform's value constant when optical phase of adjacent bits are the same [0046].

In claims 74 and 86 of the present invention, the term NRZ pulse refers to a pulse having a bell-shaped-like or sinusoidal-like shape such that the pulse peak does not extend to the entire bit period. Furthermore, the wings of the pulse do not extinguish completely regardless of the bit pattern. The NRZ pulse of claims 74 and 86 of the present invention is clearly defined in the specification along with its extinction ratio, see Figure 1f and paragraph [0068]. Therefore, the term NRZ pulse is different than conventional NRZ signal, as described by Bergano, et al. The NRZ pulse shape of claims 74 and 86 provides optimization of the optical pulse shape and its spectral content. This optimal pulse shape provides the best balance between the desire for narrow optical pulse to mitigate fiber nonlinear impairments and the need for narrow spectral content of the pulse to suppress adjacent WDM channels crosstalk. The transmission performance is often maximized when such a balance is achieved. The NRZ pulse of claims 74 and 86 is more general and versatile than a conventional NRZ pulse.

Claims 75-78 and 80-82 provide ranges of parameters of the optical fiber (e.g., the zero-dispersion wavelength and the dispersion parameter) for PSK signal transmission using RZ and NRZ pulses disclosed in claims 73 and 74.

Claims 83 and 91-94 describe the concept and technique on how to optimize transmission performance of WDM optical channels with PSK format in optical fibers. Taga's RZ pulse addresses the polarization effect only and the extinction ratio is based on single-channel (see Figures 1 and 4 of Taga, et al,) OOK format only in which the RZ pulse is simply turned on and off to represent logic values of one and zero (see Figure 2C of Taga, et al.). The pulse shape of Taga, et al., addresses neither fiber nonlinearities nor WDM crosstalk. Claims 83 and 91-94 include WDM or multiple densely spaced optical channels of PSK RZ with pulse shaping.

Regarding claims 85 and 87-90, Liu, et al., requires and specifies a PSK of RZ optical pulse in conjunction with polarization interleaving (paragraph [0005] and in Figure 1) before embedding into an optical fiber or a fiber optic network. The requirement of orthogonal polarizations applies to all optical channels before combining them into a single optical fiber. Furthermore, the PSK pulse shape such as extinction ratio is not specified in Liu, et al.,. In the present invention, however, no particular polarization states of the PSK signals is imposed or required for any optical channels. Since the PSK pulse shape defined and specified in our application determines the spectral bandwidth, spectral overlap or crosstalk between closely spaced optical channels must be carefully considered. Consequently, the wavelength combiner or wavelength division multiplexer of claims 85 and 87-90 is different from Liu, et al.

Regarding claim 85, the pulse modulator provides the pulse shaping capabilities for the PSK signal. The concept of controlling the PSK pulse shape is controlled through the pulse modulator to balance channel crosstalk and fiber nonlinearities, which is not taught by Liu, et al., or Bergano, et al.

With regard to claims 87 and 88, Liu, et al., does not disclose a means of producing either BPSK or QPSK. Liu, et al's optical BPSK or QPSK signal is not the same as the BPSK or QPSK signal of claims 87 and 88. In claims 87 and 88, a Mach-Zehnder modulator (MZM) with switching voltage of V_π , and biased at null with close to $2V_\pi$ drive swing voltage, produces the BPSK optical signal. For the QPSK optical signal, a pair of parallel MZMs with switching voltage of V_π , and biased at null with close to $2V_\pi$ drive swing voltage, can be used to produce the QPSK optical signal. The BPSK or QPSK signal of claims 87 and 88 are different from Liu, et al.

Regarding claim 89, the pulse modulator provides the pulse shaping capabilities for the PSK signal. Liu, et al., and Bergano, et al. fail to provide this.

Referring now to Figure 1 of Liu, et al., the optical signal launched into the phase modulator (121) is not CW but rather optical pulses produced by the pulse carver (102). In claim 90, the CW light source is provided to generate the PSK signal such that the case of the modulating the phase of CW light directly (not pulsed light as in Figure 1 of Liu, et al.,) is not excluded. Furthermore, the configuration of Figure 1 in Liu, et al., is questionable. The phase modulator (121) shown in Figure 1 is a high-speed optical device that operates at least 10 Gbits/s. It is well-known that such phase modulator is constructed and available only from lithium niobate material which is sensitive to the state of polarization of the light. In Figure 1 of

Liu, et al., two orthogonal polarizations after 111 are injected into the phase modulator (121), and the PSK modulation of the two polarizations is significantly different due to polarization sensitivity of the phase modulator. As a result, the transmission performance of the two polarizations is different.

CONCLUSION

It is submitted that the present application is in form for allowance, and such action is respectfully requested.

The Commissioner is authorized to charge any additional fees which may be required to Deposit Account 08-1641 (39878-0017).

Respectfully submitted,
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